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Chapter 12

A rapid assessment of mammals of the Nassau and Lely plateaus, Eastern Suriname

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INTRODUCTION

Mammals, along with birds, constitute the most important groups of vertebrates in terms of economic importance for people. They are found everywhere in the World, and recent estimates suggest more than 5400 species (Wilson and Reeder 2005). In the Neotropical region, they are very diverse and some groups are exclusive to this geographic area. Small mammals, such as opossums, bats, and rodents, are particularly diverse and constitute a primary component of the Neotropical rainforests (Eisenberg 1989, Emmons and Feer 1997, Voss and Emmons 1996). Through seed dispersal, pollination, mycorhizal dispersal and control of insect populations and as part of the food chain for carnivorous animals, the small mammals help in the natural functions of ecosystems. A role as indicators of environmental change has also been shown for these groups (Ascorra et al. 1996, Solari et al. 2002), with larger herbivores and carnivores acting as "umbrella species" (Primack 2002) rather than indicator themselves.

The forest of northern South America, and the Guianas specifically, support a number of small mammals in various habitats (Eisenberg 1989, Engstrom and Lim 2002, Husson 1978, Lim and Engstrom 2002; Lim et al. 2005, Simmons and Voss 1998, Tate 1939, Voss and Emmons 1996, Voss et al. 2001); in the Guayana Shield, almost 10% of the 282 mammal species known to occur may be endemic (Huber and Foster 2003). At the Nassau and Lely Mountains (Eastern Suriname), our main goal was to obtain baseline information through an inventory of mammals in most of the several habitats there presents, with emphasis on the factors affecting the sampled communities. The area has great importance because of its biodiversity (see Lim et al. 2005), its geographic location nearby areas well studied in recent times (Lim et al. in press), and also by the chance to study potential effects of mining exploitation on its mammal communities.

The Initial Biodiversity Assessment and Planning (IBAP) program of Conservation International (CI) was carried out in conjunction with BHP-Billiton Maatschappij Suriname (BMS) and the Suriname Aluminum Company LLC (SURALCO) to survey the biological diversity of the Lely and Nassau Mountains of eastern Suriname. Given that these mountains fall into an area with high priority for conservation in the Guayana Shield (Huber and Foster 2003), our aim was to provide a rapid survey of the mammals in the area to increase our understanding of the whole ecosystems and help in future decisions about mining exploitation. With these data, we compare the diversity found in the sampled areas, between them and also between eastern Suriname and others in the Guayana Shield.

MATERIALS AND METHODS

Study Area

We conducted our study from October 25 through November 06, 2005, at the beginning of the dry season. We worked for one week at each sampling site; the first locality was the Nassau Mountains (25-31 October), at 04°49.23' N, 54°36.34' W, 514 masl, and the second locality was Lely Mountains (1-6 November), at 04°16.23 N, 54°44.29" W, 640 masl. Both sites are

located in the District of Sipalawini, being part of a large system of bauxite plateaus in northeastern Suriname that may represent a rare and endangered landscape type, with several potential endemic elements. Both sites included lowland well drained (*terra firme*) tropical forest, with a relatively closed canopy of 20-25 m, along with disturbed primary forest and secondary forest, with lower and open canopy. At Nassau, there was much secondary-growth, which is a consequence of previous mining (bauxite) exploration. There was a road connecting several small camps, and forest clearing was pretty common in the area. A small stream was located near the main camp, as well as a large clearing. At Lely, we sampled around the air strip, which is surrounded by bushes and small trees. We also trapped in the savannah forest located close to the radio antenna, which was characterized by the presence of bromeliads and sparse and small-size trees. Some sampling was done along a stream with irregular topography and dense vegetation. Camera traps were located within two-hour walking distance in a well preserved forest near abundant water bodies.

Collecting methods

We used a combination of several methods to detect and collect mammals (see Wilson et al. 1996a). For non-flying small mammals, rats and opossums, we used a transect design consisting of two trap lines, one with 80 stations and the other with 40 stations. Stations were set 8-10 meters apart of each other, each including a combination of snap (Victor, mouse size) and live (Sherman) traps, or two snap traps. This method allows for sampling several habitats within a given portion of the locality. Traps were set on the ground, near burrows or along potential runways near large trees or in other suitable spots. A variable proportion of traps, between 20-30% of the total, were set on branches or at some height over the ground, intending to capture more arboreal species. Traps were baited with a mix of peanut butter, rolled oats, and vanilla, or sardines in oil, and checked twice a day (morning and evening). Total trapping effort was calculated as the total number of traps set each night.

Mist nets were used to capture bats; we set nets along probable flight ways, like creeks, streams, forest edges, or within forest with both dense and scarce understorey. Our decision to place nets was based on potential abundance of bats in the surrounding habitat either because of presence of food resources or roost sites. Most of the nets, 6-8 each night, 12 m long, were set 2 m above the ground, with a few ones going almost 5 m above the ground. Nets were open from dusk to midnight or so, in just a few nights the nets were open until dawn. Netting effort was calculated as the total number of nets set each night. We tried to keep a standard trapping/netting effort for both localities to make direct comparisons.

For large mammals, we searched for tracks of medium and large species along the roads and trails; for each record we took data on time and relative position in regard to the main camp. Field guides (Emmons and Feer 1997) were used to identify these tracks. In a few cases, we were able to see or hear the animals during our daily excursions from and to camp, and make an identification at that time. We also used 4-6 camera traps operating continuously and located nearby an odor bait (feline urine), or sites that showed some mammal activity. In a few instances, members of other field crews provide information about other records that were identified using field guides. Finally, we interviewed local residents about the species they know for sure were present at the area.

Because it was a rapid inventory, we only compared results between sites, based on our standard trapping/netting. We did not calculate expected species richness based on our data, but compared our list to existing ones for the region (i.e., Brownsberg mammals; Lim et al. in press). Voucher specimens were prepared as whole animals fixed in 10% formalin with final storage in 70% ethanol; individuals were examined for ectoparasites and "wrapped" in cheesecloth for future examination. To verify field identification, skulls were removed from selected specimens. Tissue samples (liver and muscle) were saved in lysis buffer (Longmire et al. 1997). The specimens will be deposited in the Mammal Collection of the Museum of Texas Tech University, USA.

RESULTS AND DISCUSSION

Species Diversity

Overall, 45 species of mammals from nine orders were recorded from the two study sites in Eastern Suriname, as expected the orders Chiroptera (bats) and Rodentia (rodents) were the most diverse (Appendix 17). All small mammal species were represented by specimens. We recorded one species of marsupial, two species of rodents, and 24 species of bats (most of the captured bats were released in the field after positive identification). One pigmy squirrel, *Sciurillus pusillus*, was seen and positively identified in the Lely Mountains camp. An unusual record of medium-size and big mammals was recorded at both places, but it was more evident at Lely Mountains camp. From the first site, Nassau Mountains, we recorded six orders and 28 species; at Lely Mountains, we recorded eight orders and 30 species (Appendix 17).

After ten trapping days, five nights at each locality, our total effort included 900 Victor mouse trap nights and 540 Sherman trap nights. We caught one opossum and five rodents in total, which give us an overall success rate of 0.4%. Abundance data were extremely scarce for non-volant small mammals, but we had a chance to analyze our collecting data on bats for some discussion. The most abundant species was the fruit-eating bat *Artibeus planirostris*, which accounted for almost 40% of total captures at both sites; the second most common species was *Carollia perspicillata*, with almost 20% of captures. In general, fruit-eating bats of the subfamilies Stenodermatinae and Carollinae (Phyllostomidae) dominated the bat faunas at both localities. Only one (*Pteronotus parnelli*) out of 23 species of bats represented a different family, Mormoopidae. Although fruit-eating spe-

cies were the most diverse, with 16 species, the second most diverse trophic guild includes the gleaning insectivores of the subfamily Phyllostominae, with 4 species. The remainder species included one nectar-feeding (*Lionycteris spurrelli*), one insectivore-carnivore (*Trachops cirrhosus*), and one omnivorous (*Phyllostomus discolor*) bat.

Absence of small rodents at Nassau might be explained by either deficient trapping effort, or real lacking of habitats for these species; we cannot draw any definitive conclusions given the short sampling period, but also the small sample size (4 animals) at Lely. We recorded two sympatric species of *Neacomys* at Lely; although based on preliminary identifications needing further comparison and perhaps verification through genetic data, we believe that this remarks how little we know about the geographic limits of these species, which usually are a main component of the local diversity (Lim et al. 2005). As an example, our records of *N. dubosti* and *N. guianae* seem to be the first for northeastern Suriname, based on the data from Lim et al. (in press) and Voss et al. (2001).

We recorded visually, by sound, or by tracks 17 species of medium and large mammals in both localities. There was a large difference in species composition between the two sites, with more species (13) at Lely than in Nassau (8). The most diverse groups were the Primates and the Carnivora, each with four species; the first includes large (*Alouatta macconnelli*, *Ateles paniscus*, *Chiropotes chiropotes*) and small (*Saguinus midas*) monkeys, while the second includes two large (*Panthera onca*, *Puma concolor*) and one small (*Leopardus pardalis*) cat, plus one coati (*Nasua nasua*). Most of these records occurred not too far from the main camp, and in some cases (*S. midas*) included more than one individual. We observed den sites for Brazilian tapir in many places around the camp in Nassau, but not so commonly in Lely. At both study sites, we found tracks of brocket deer (*Mazama*), but without a visual record it was impossible to identify to species (*americana* or *gouazoubira*), as both are known in the area.

There were no pictures of animals on the seven rolls of picture used in the camera traps; four were set off by the sunlight and the camera went through the whole roll. The other three consisted of only a few pictures each that were of either initial set up or of a RAP participant walking through. We believe that our camera trapping design was severely affected by our inexperience and logistic difficulties at the study sites, but the method remains a valid one for record of animals that otherwise went undetected in similar studies (Sanderson and Trolle 2003, Lim et al. 2005).

SPECIES AND GROUPS OF IMPORTANCE

Considering the numbers of species as well as their ecological roles, preliminary results indicate that Lely has higher taxonomic and ecologic diversity. These results suggest that the forest at Nassau is less suitable for small non-volant mammal species, probably because of the alteration of primary forests. For instance, frugivorous bat were predominant at Nassau, as we would expect in secondary growth forests, forest borders, or dynamic habitats (Wilson et al. 1996b), such as those sampled in this site. At Lely, we recorded a better representation of Phyllostominae bat species (which are omnivorous or insectivorous), indicating a more complex forest structure (Wilson et al. 1996b) than in Nassau. Most of the species of bats we recorded at both sites has a wide geographic distribution in the Neotropics (Simmons 2005); the exception was *Ametrida centurio*, which is a small fruit-eating bat restricted to the Guayana Shield and northern Brazil, although usually common through. However, some animals could represent nominated subspecies with a narrower distribution, like *A. planirostris trinitatis* or *P. parnelli rubiginosus*, and their populations deserve further study. It is remarkable that only three bat species are listed as threatened, *Lophostoma carrikeri* (Vulnerable), *Koopmania concolor* (Lower Risk - Near Threatened), and *Artibeus obscurus* (Lower Risk - Near Threatened); we believe that the first two are locally rare species, but their wide geographic range does not suggest any real threat to its survival. However, the case of *A. obscurus* is due to the taxonomic confusion in regard to the large *Artibeus*, which has caused very few confirmed records of this species, which is usually common in well studied areas (Ascorra et al. 1996, Lim and Engstrom 2002)

Among the 17 species of medium and large mammals we recorded, a few deserve some concern because of their conservation status. Most of the Primates and Carnivores are listed by IUCN as endangered at the global level; among the monkeys, *A. macconnelli* is listed as Vulnerable and *Ch. chiropotes* (for distinction of this species, see Groves 2005) as Data Deficient, although as part of *Ch. satanas* it was listed as Endangered, mostly because they are directly affected by local hunting. At the same time, both are restricted to the Guiana region, so their global conservation depends on the status of these populations. Other species, like *S. midas* and *A. paniscus*, both also endemic to the Guiana region, have more stable populations and are therefore listed as Lower Risk - least concern. Among the Carnivores, the larger cats are listed as Lower Risk - near threatened, meaning that their populations are close to become Vulnerable if they are locally affected. Observations in areas within the Guiana region suggest that their populations remain low, although apparently stable (Lim et al. in press, Voss et al. 2001). The smaller ocelot (*L. pardalis*) has equally a larger distribution, but is regarded as Lower Risk - least concern because its more stable populations. It is interesting that many of these records occurred within our range of daily activity, not far from the main camp. Among the ungulates, the Brazilian tapir (*T. terrestris*) is listed as Vulnerable, because this is heavily affected by hunting everywhere, and we found evidence that the same occurs in this region; however, the collared peccary (*P. tajacu*) with less hunting pressure and larger populations is listed as Lower Rosk - least concern. Another species isted as Vulnerable is the giant anteater (*M. tridactyla*), which seems to be locally uncommon (Voss et al. 2001).

At both places, diversity and concentration of medium and large mammals (e.g. almost every day we found feces of Tapir in both places) suggest suitable habitats for these species, which usually require large extensions of not too disturbed forest. The presence of ungulates may be the reason behind the presence of large cats (cougar and jaguar) in the area. Many of the Primate species we identified in the area were based on remains collected near the sampling site at Lely, but groups of *Saguinus midas* and *Alouatta macconnelli* were evident at both places and they seem to have healthy populations, as noted by Voss et al. (2001) for Paracou, French Guiana, suggesting a wider, regional pattern. However, we consider that imminent pressures as habitat loss and hunting could may be threatening large mammals, and their predators, at both places.

We caution that any inference about the status of the mammal fauna in both sites is still incomplete and far from accurate, the short sampling period does not allow for further analyses or comparisons with other better sampled areas in the region. A more extensive survey is required to determine real patterns of the mammalian assemblage.

CONSERVATION RECOMMENDATIONS

We suggest a more rigid control of hunting in both surveyed places and, if possible, allow mining only if high environmental controls are designed. Small mammals are more dependent of forest structure for their survival, reducing clearings to a minimum would preserve this structure and the fauna living there (Granjon et al. 1996). Deforestation in some places has been severe, as evidenced by the high diversity of fruit-eating bats, which favor this kind of dynamic ecosystem (Wilson et al. 1996b).

By regulating the traffic through the road communicating the camps, it could be possible to know the impact of people and/or hunters that access these forests. It was evident from our observations that rural populations around main settlements access the forests with no limits at all, for hunting, fishing, and harvesting non-timber products. Only a strong control could conserve these places that harbor and important and still completely unknown mammal diversity, some elements of which could be endemic to this region (Lim et al. 2005). Because of surrounding gold-mining activities at both places, populations of large animals (e.g., ungulates, monkeys) are usually low because of over-hunting. This is more evident at Nassau, due to more local settlements nearby but also by the more remote location of Lely.

Although some degree of protection has been set for this particular ecosystem, through Brownsberg Nature Reserve (Lim et al. in press), we believe that further studies should be completed before to allow exploitation of the surrounding areas. We lack significant data on the variation of reproductive patterns, microhabitat preferences, morphology and ecology that may be associated with geographic distribution over the mosaic of habitats included in this region. This must go along with an improvement of our sampling techniques. Although time may not be enough to compile such a large dataset, we might focus on the most significant species, from a conservation (e.g., primates), ecological (e.g., bats), or taxonomic (e.g., muroid rodents) point of view to improve the current assessment.

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Appendix 17

Mammal species recorded on the Nassau and Lely plateaus during the RAP survey.

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IUCN Red List Categories of threatened species (IUCN 2006): Data Deficient (DD, not enough is known to make an assessment), Near Threatened (NT), Least Concern (LC, listed but not threatened), and Vulnerable (VU).

CITES Appendices I, II and III list species afforded different levels or types of protection from over-exploitation (see http://www.cites.org/eng/app/index.shtml).

Order	Family	Genus	Species	English common name	IUCN Red List Category	CITES Appendix	Endemism	Nassau	Lely
Chiroptera	Mormoopidae	*Pteronotus*	*parnelli*	Common Mustached bat	LC				x
Chiroptera	Phyllostomidae	*Lophostoma*	*carrikeri*	Carriker's Round-eared Bat	VU				x
Chiroptera	Phyllostomidae	*Lophostoma*	*silvicolum*	White-throated Round-eared bat	LC				x
Chiroptera	Phyllostomidae	*Micronycteris*	*minuta*	Tiny Big-eared bat	LC				x
Chiroptera	Phyllostomidae	*Phyllostomus*	*discolor*	Pale Spear-nosed bat	LC			x	
Chiroptera	Phyllostomidae	*Tonatia*	*saurophila*	Stripe-headed Round-eared bat	LC			x	x
Chiroptera	Phyllostomidae	*Trachops*	*cirrhosus*	Fringe-lipped bat	LC			x	x
Chiroptera	Phyllostomidae	*Lionycteris*	*spurrelli*	Chestnut long-tongued bat	LC			x	
Chiroptera	Phyllostomidae	*Carollia*	*brevicauda*	Silky Short-tailed bat	LC			x	x
Chiroptera	Phyllostomidae	*Carollia*	*perspicillata*	Seba's Short-tailed bat	LC			x	x
Chiroptera	Phyllostomidae	*Rhinophylla*	*pumilio*	Dwarf Little Fruit bat	LC			x	x
Chiroptera	Phyllostomidae	*Ametrida*	*centurio*	Little White-shouldered bat	LC			x	
Chiroptera	Phyllostomidae	*Artibeus*	*lituratus*	Great Fruit-eating bat	LC			x	
Chiroptera	Phyllostomidae	*Artibeus*	*obscurus*	Dark Fruit-eating bat	NT			x	x
Chiroptera	Phyllostomidae	*Artibeus*	*planirostris*	Flat-faced Fruit-eating bat	LC			x	x
Chiroptera	Phyllostomidae	*Chiroderma*	*trinitatum*	Little Big-eyed bat	LC			x	
Chiroptera	Phyllostomidae	*Chiroderma*	*villosum*	Hairy Big-eyed bat	LC			x	x
Chiroptera	Phyllostomidae	*Dermanura*	*gnoma*	Dwarf Fruit-eating bat	LC				x
Chiroptera	Phyllostomidae	*Koopmania*	*concolor*	Brown Fruit-eating bat	NT			x	
Chiroptera	Phyllostomidae	*Platyrrhinus*	*helleri*	Heller's Broad-nosed bat	LC			x	
Chiroptera	Phyllostomidae	*Sturnira*	*lilium*	Little Yellow-shouldered bat	LC			x	
Chiroptera	Phyllostomidae	*Sturnira*	*tildae*	Tilda's Yellow-shouldered bat	LC			x	x
Chiroptera	Phyllostomidae	*Uroderma*	*bilobatum*	Common Tent-making bat	LC			x	
Chiroptera	Phyllostomidae	*Vampyrodes*	*caraccioli*	Great Stripe-faced bat	LC			x	

Order	Family	Genus	Species	English common name	IUCN Red List Category	CITES Appendix	Endemism	Nassau	Lely
Didelphimorphia	Didelphidae	*Marmosa*	*murina*	Linnaeus's Mouse opossum	LC		Guiana region	x	
Primates	Cebidae	*Saguinus*	*midas*	Red-Handed tamarin	LC	II	Guiana region	x	x
Primates	Atelidae	*Alouatta*	*macconnelli*	Guyanan Red Howler	VU	II	Guiana region	x	x
Primates	Atelidae	*Ateles*	*paniscus*	Red-faced Spider monkey	LC	II	Guiana region		x
Primates	Pitheciidae	*Chiropotes*	*chiropotes*	Red-backed Bearded Saki	DD	II	Guiana region		x
Carnivora	Felidae	*Pantera*	*onca*	Jaguar	NT	I			x
Carnivora	Procyonidae	*Nasua*	*nasua*	South American coati	LC				x
Carnivora	Felidae	*Leopardus*	*pardalis*	Ocelot	LC	I		x	
Carnivora	Felidae	*Puma*	*concolor*	Cougar	NT	II		x	
Perissodactyla	Tapiridaee	*Tapirus*	*terrestris*	South American tapir	VU	II		x	x
Artiodactyla	Cervidae	*Mazama*	sp.	Brocket deer	DD			x	x
Artiodactyla	Tayassuidae	*Pecari*	*tajacu*	Collared peccary	LC	II		x	
Cingulata	Dasypodidae	*Dasypus*	*novemcinctus*	Nine-banded armadillo	LC				x
Pilosa	Myrmecophagidae	*Myrmecophaga*	*tridactyla*	Giant anteater	VU	II			x
Rodentia	Dasyproctidae	*Dasyprocta*	*leporina*	Red-rumped Agouti	LC			x	
Rodentia	Sciuridae	*Sciurillus*	*pusillus*	Neotropical Pygmy squirrel	LC				x
Rodentia	Cricetidae	*Neacomys*	*dubosti*	Dubost's Neacomys	DD		Guiana region		x
Rodentia	Cricetidae	*Neacomys*	*guianae*	Guiana Neacomys	LC		Guiana region		x
Rodentia	Erethizonidae	*Coendou*	*prehensilis*	Brazilian Porcupine	LC				x
Rodentia	Dasyproctidae	*Myoprocta*	*acouchy*	Red acouchi	LC				x
Rodentia	Echimyidae	*Proechimys*	*guyannensis*	Guyenne Spiny Rat	LC		Guiana region		x
Total number of species	**45**							**28**	**30**